

3.17 TOPOGRAPHY, GEOLOGY, SOILS, AND MINERAL RESOURCES

This section focuses on erosional impacts from construction of the habitat conservation measures. The conservation measures would be implemented within the historic floodplain of the LCR or its tributaries, where the topography is generally flat-lying. Project grading, excavating, and dredging would not substantially alter the topography of the floodplain because it would only be altered enough to establish land cover types in the conservation areas and build roadways. Therefore, topographic impacts are not discussed in the following section. Similarly, construction would be limited to two prefabricated field offices, fish-rearing facilities, and miscellaneous water conveyance structures (e.g., pipelines). These structures would be constructed in accordance with seismic standards established in the Uniform Building Code; thus, potentially severe earthquake-induced ground motion would have minimal impacts on these components of the project. Therefore, seismic impacts are not discussed in the following section. Impacts to mineral resources also are not discussed because implementation of the proposed action would not interfere with any existing or foreseeable mineral extraction operations. The primary mineral resource of commercial importance in the vicinity of the LCR and its tributaries is crushed stone aggregate. Sources of this mineral are typically bedrock areas of high relief and minimal floodplain development, which are unfavorable for conservation area establishment.

3.17.1 Affected Environment

3.17.1.1 Lower Colorado River

Topography, Geology, and Soils

The LCR area of Arizona, Nevada, and California is located in the lower portion of the Basin and Range geomorphic province, within the western Sonoran Desert. This area is characterized by numerous mountain ranges that rise abruptly from broad, plain-like valleys or basins. The basins are composed of silt-filled channels and alluvial fans, fan terraces, and floodplains, consisting of Quaternary sand, gravel, and conglomerate. Limited soil horizon development indicates young, unstable alluvial and floodplain surfaces of late Holocene age, subject to periodic flooding, sedimentation, and dynamic alteration.

The LCR generally consists of narrow stretches confined by resistant bedrock cliffs and bluffs and broad areas lined by low-lying alluvial floodplains. The bedrock areas generally lack organic soil development and would likely not be suitable for conservation area vegetation establishment activities. However, alluvial floodplain areas are generally mantled by soil profiles sufficient to support agricultural activities (USDA Soil Conservation Service 1974, 1986). Therefore, conservation area establishment activities would also likely be most appropriate in these areas.

The active floodplain is bounded by steep, active slopes (escarpments), active sand dunes, and washes (arroyos). The floodplain has low relief and includes the stream channel and associated features such as point bars and abandoned channels or meanders. Sand splays, point bars, and meander scrolls are typically underlain by coarse-grained alluvium, whereas broad shallow channels and backswamps are more clay-rich (Parsons et al. 1986).

1 The soils on the Colorado River floodplain are saline. The salinity is the result of accumulated
2 salts from alluvial deposits and subsequent evaporation of soil moisture. The rainfall is not
3 sufficient to leach these salts below the plant root zone; therefore, a continuing accumulation of
4 salts occurs. These salts are primarily calcium, sodium, magnesium, chloride, and sulfate. An
5 excessive amount of toxic salts in the soil can delay or prevent seed germination, decrease
6 available water capacity, interfere with plant growth, and impede the movement of air and
7 water through the soil. Intensive management is required to minimize salinity to levels that do
8 not inhibit plant growth (USDA Soil Conservation Service 1986).

9 **3.17.1.2 Muddy River/Moapa Valley and Virgin River**

10 From the Overton Arm of Lake Mead, the Muddy River trends northwest through alternating
11 areas of relatively flat-lying, alluvial-filled valleys and steeper topography of the North Muddy
12 Mountains, which are underlain by sedimentary and volcanic strata (Nevada Bureau of Mines
13 and Geology [NBMG] 1978). From the Overton Arm of Lake Mead, the Virgin River trends
14 north-northeast through the Virgin Valley, located between the Mormon Mesa to the west and
15 Black Ridge to the east. This valley gradually broadens toward the northeast. Sedimentary
16 rocks underlie the Mormon Mesa and metamorphic rocks underlie the Black Ridge. Quaternary
17 alluvium underlies the floor of the Virgin Valley, immediately adjacent to the river (NBMG
18 1978). Soils overlying the low-lying, alluvial fans and floodplains in the Lake Mead area
19 generally consist of deep, medium- to coarse-textured, nearly level to gently sloping soils. Soils
20 in the steeper bedrock areas generally consist of shallow, gravelly and cobbly, moderately
21 sloping to very steep soils (USDA Soil Conservation Service 1975).

22 **3.17.1.3 Bill Williams River**

23 Eastward from the Colorado River, the Bill Williams River traverses the Bill Williams
24 Mountains, the southern portion of the Castaneda Basin, and then forms the boundary between
25 the Rawhide Mountains to the north and the Buckskin Mountains to the south. Along the
26 western stretch of the river, the Bill Williams Mountains are composed of metamorphic,
27 sedimentary, and volcanic rocks. The Castaneda Basin is underlain by sandstone and
28 conglomerate, which form high rounded hills and ridges. The eastern stretch of the Bill
29 Williams River, through the Rawhide and Buckskin mountains, are similarly composed of
30 metamorphic, sedimentary, and volcanic rocks (Arizona Geological Survey [AGS] 2000). Soils
31 along the mountainous portions of the river consist primarily of shallow, gravelly and cobbly,
32 moderately coarse to moderately fine-textured, gently sloping to very steep soils and rock
33 outcrop on hills and mountains. The portion of the river that traverses the Castaneda Basin are
34 composed of deep, medium-textured, limy and gravelly, moderately coarse- and coarse-
35 textured, nearly level to moderately sloping soils on floodplains and dissected alluvial surfaces
36 (USDA Soil Conservation Service 1975).

37 **3.17.1.4 Lower Gila River**

38 Eastward from the Colorado River, the lower Gila River traverses a gap through a narrow band
39 of northwest-trending mountains, composed of the Gila Mountains to the south and the Laguna
40 Mountains to the north, and then trends south of the Muggins Mountains, through the broad,
41 flat-lying Dome and Mohawk valleys. The northwest trending Mohawk Mountains terminate
42 just south of the river in the eastern Mohawk Valley. Sedimentary rocks are present along the

river through the short section between the Gila and Laguna mountains, as well as at the north end of the Mohawk Mountains. The portion of the river traversing the Dome and Mohawk valleys is underlain by river alluvium, consisting primarily of unconsolidated to weakly consolidated sand and gravel in river channels and sand, silt, and clay on floodplains (AGS 2000). Soils along this section of the lower Gila River primarily consist of deep, stratified, coarse- to fine-textured nearly level to gently sloping soils on floodplains and lower alluvial fans (USDA Soil Conservation Service 1975).

3.17.2 Environmental Consequences

Significance Criteria

The project would have a significant impact on geology, soils, and minerals if it would result in substantial soil erosion or the loss of topsoil.

3.17.2.1 Alternative 1: Proposed Conservation Plan

Impacts

Impact GEO-1: Activities associated with conservation area establishment could result in erosion-induced siltation of the Colorado River. Conservation area establishment would include such actions as clearing vegetation, grading, excavating, dredging, stockpiling soil, construction/modification of supply canals, berm construction, and swale construction. Each of these activities could result in increased soil erosion and associated sedimentation of the Colorado River, which in turn, would result in adverse water quality impacts. Less clearing and grading would be required if agricultural land were used instead of undeveloped land; erosion-induced siltation could occur, however, just to a lesser extent. Standard BMPs have been included as part of the proposed action (refer to section 3.0), and could include construction of silt fences, revegetation, minimization of grading (to the extent possible), construction of surface water velocity reducers, and installation of erosion control barriers around stockpiled soil. Given the implementation of these BMPs, impacts would be *less than significant* since substantial soil erosion and loss of topsoil would not occur.

Mitigation Measures

No mitigation measures are required because no significant impacts would occur.

Residual Impacts

Residual impacts are those that would occur after the implementation of mitigation measures to reduce an impact. No mitigation measures are required; thus, no residual impacts would occur.

3.17.2.2 Alternative 2: No Action Alternative

Under the no action alternative, it is likely that conservation measures similar to those included in the proposed action would be implemented since compliance with the ESA still would be required for the covered activities, although some conservation could occur in the off-site conservation areas (as described in section 3.17.2.4 below), as well as along the LCR. **Impact GEO-1** applies to Alternative 2. To the extent that the agencies undertaking the covered

activities proceed with ESA compliance through section 7 consultations instead of the section 10 permitting process, there may be a reduced number of covered species because unlisted species would not be included. This would likely result in a smaller amount of conservation area being established and proportionately lessened impacts related to erosion-induced siltation.

Mitigation Measures

No mitigation measures are required because no significant impacts would occur.

Residual Impacts

Residual impacts are those that would occur after the implementation of mitigation measures to reduce an impact. No mitigation measures are required; thus, no residual impacts would occur.

3.17.2.3 Alternative 3: Listed Species Only

Impacts

Impact GEO-1 applies to Alternative 3. The same types of impacts would occur as described for the proposed action, but the overall magnitude would be lessened proportionately since less construction would occur.

Mitigation Measures

No mitigation measures are required because no significant impacts would occur.

Residual Impacts

Residual impacts are those that would occur after the implementation of mitigation measures to reduce an impact. No mitigation measures are required; thus, no residual impacts would occur.

3.17.2.4 Alternative 4: Off-Site Conservation

Impacts

Impact GEO-1 generally applies to this alternative. This impact would be substantially the same as described for the proposed action (*less than significant*) since the same overall amount of conservation area would be established. Impacts from the establishment of cottonwood-willow, honey mesquite, and marsh would occur along the Muddy/Virgin, Bill Williams, and lower Gila rivers. To the extent that impacts would result from backwater creation, they would occur in the planning area under this alternative, as well as under the proposed action.

Mitigation Measures

No mitigation measures are required because no significant impacts would occur.

1 *Residual Impacts*

- 2 Residual impacts are those that would occur after the implementation of mitigation measures to
3 reduce an impact. No mitigation measures are required; thus, no residual impacts would occur.

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